

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge Massachusetts

LUMINARY Memo #60

To: Distribution
From: J. Kernan, P. Volante
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Subject: LUMINARY Level 5 Test Plan

Level 5 testing of the LUMINARY program consists of:

1. Rerunning selected Level 4 tests (some with modifications).
2. Specific tests requested by MSC as a result of the pre-FACI review.
3. Selected Level 3 tests.

All Level 4 reruns include the following instrument errors:

1. Radar

| | Bias | Std. Deviation of Noise |
|------------------|----------|-------------------------|
| Range | 500 ft * | .3% Range |
| | 80 ft ** | Same |
| Range-Rate | .3 fps | 1.3/3% Range Rate |
| Shaft & Trunnion | 15 mr | .9 mr |

2. IMU - The uncompensated IMU errors are:

| | |
|-------------------------|--------------------------------|
| Pipa Bias | +.2 CM. /Sec in each component |
| Pipa Scale Factor Error | -120 PPM in each component |
| Gyro Bias Drift | +2 meru in X |
| | -2 meru in Y |
| | +2 meru in Z |

* If Range > 50.8 N.M.

** If Range < 50.8 N.M.

| | |
|-------------------------------------|--|
| Input Axis Sensitive Drift | -8 meru/G in X +8 meru/G in Y -8 meru/G in Z |
| Spin Reference Axis Sensitive Drift | +5 meru/G in each axis |

The tests being run in each category are:

1. Level 4 Reruns

| Test Description | Responsible Engineer |
|--------------------------------------|----------------------|
| 5.1 Tests 4.3 and 4.5 combined | Eyles/Covelli |
| 5.2 Test 4.4 | Bernikowich/Covelli |
| 5.3 Test 4.6 | Batra/Covelli |
| 5.4 Test 4.7 | Finkelstein/Covelli |
| 5.5 Test 4.10 | Berman/Covelli |
| 5.6 Tests 4.11 and 4.13 combined | White |
| 5.7 Test 4.15 with TPI-TPM added | Connor/White |
| 5.8 Tests 4.16 and 4.18 combined | Gamer/White |
| 5.9 Test 4.19 with SOR-TPI-TPM added | Albert/White |
| 5.10 Test 4.27 | Hatch/White |
| 5.11 Test 4.28 | Wiggins/White |
| 5.12 Test 4.30 | Dunbar/White |

2. MSC Requested Tests

| | |
|--|---------|
| 5.13 P32 with N=5 C=0 | White |
| 5.14 Same as 5.13 with different initial conditions | White |
| 5.15 Same as 5.13 except C \neq 0 | White |
| 5.16 Same as 5.14 except C \neq 0 | White |
| 5.17 P32 with N=5, C=0, V_r = 6.8 fps | White |
| 5.18 Same as 5.17 except V_r = 7.2 fps | White |
| 5.19 P32 - Alarm 602 | White |
| 5.20 P32 - Alarm 603 | White |
| 5.21 P00 Integration | Wiggins |
| 5.22 4.13 Run with Navigation at ranges less than 5000 meters | White |

5.23 P20 with V32 response to Alarm 503 Dunbar

5.24 P20 with V32 and V34 responses to Alarm 525 and to V06N05 (Delta Theta Display) Dunbar

5.25 P22 in no update (with Downlink edit) - Test 4.8 Millard

5.26 P21 (LM option) with LM on lunar surface - Test 4.29 Dunbar

5.27 R04 in P47 - Test 4.1 (with Downlink edit) Batra

5.28 A backward integration over more than one revolution Dunbar

5.29 R29 downlink check - Test 4.10 Berman

5.30 Verify Alarm 1706 in P40 and P42 (This was done on the Hybrid) Adler

5.31 Docked DPS external Delta V burn with 5 seconds at 10% thrust and 21 seconds at 40% thrust - Test 4.21 Fisher

5.32 Same as 5.31 except the burn is a Lambert targetted burn (P31-P40) - Test 4.2 Fisher

5.33 Run P47 from TPM to near intercept with PIPA bias error Adler

5.34 A 30-second duration P42 burn with an astronaut slippage or TIG and astronaut termination. R30 continuously operated during burn - Test 4.25 (modified) Braunhardt

5.35 P31-P42 burn with engine fail at the end of the burn Kirven

5.36 P40 burn with desired V_G less than that accumulated during ullage Kirven

5.37 Verify vertical rise logic with PCR 258 - Test 4.10 Berman

5.38 Verify RCS insertion logic (done with Level 3 test 12.3) Berman

5.39 Same as 5.38, using Level 3 test 12.4 Berman

- 5.40 Verify Alarms 511 and 523 and checklist code 500 in R12 (to be done on Hybrid) Covelli
- 5.41 Verify the reasonability test limits for velocity and altitude Covelli
- 5.42 Verify that no updating of the state vector occurs until four seconds after the detection of a data good discrete Covelli
- 5.43 Run P22 and do R21 designate when the CM is directly overhead Dunbar
- 5.44 Verify R21 operation when R21 calls R61 (Hybrid) Volante
- 5.45 Verify R21 operation during RR turn on sequence Dunbar
- 5.46 Verify that R21 does not operate when the RNDVZFLG is reset Dunbar
- 5.47 Verify that R22 calls R61 when the 30° RR tracking limit is reached (Hybrid) Volante
- 5.48 Verify that Alarm 514 is properly displayed (Hybrid) Volante
- 5.49 Verify that the 520 alarm is called and displayed properly (Hybrid) Volante
- 5.50 Verify proper operation of the V34E response to the V16N80 display in R24 Dunbar
- 5.51 Verify proper operation of R25 when the RR auto mode discrete goes from on-off and off-on Dunbar
- 5.52 Abort stage when vehicle is maneuvering at a high rate (modified Test 4.7) Braunhardt/Covelli

3. Level 3 Tests

| | | |
|------|---|---------------|
| 5.53 | IMU orientation determination | Millard/Moore |
| 5.54 | Same as 5.52 with recycle exercised | Millard/Moore |
| 5.55 | Re-align to preferred orientation | Millard/Moore |
| 5.56 | Re-align to nominal orientation using gyro torque coarse align option and realign | Millard/Moore |
| 5.57 | IMU orientation determination, re-align to landing site orientation, re-align to REFSMMAT | Millard/Moore |
| 5.58 | Re-align to preferred orientation, re-align to nominal orientation | Millard/Moore |
| 5.59 | Lunar surface preferred orientation (Level 3 Test P57.1) | Millard/Moore |
| 5.60 | Landing site orientation, option 1 (Level 3 Test P57.2) | Millard/Moore |
| 5.61 | Landing Site orientation, option 2 (Level 3 Test P57.3) | Millard/Moore |
| 5.62 | Landing site orientation, option 3 (Level 3 Test P57.4) | Millard/Moore |